TEXAS HIGHWAY DEPARTMENT

Construction & Maintenance

BULLETIN No. 27

Sept. 1953

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With this, the September issue of the Construction and Maintenance Bulletin, we close one chapter in our history and start a new one.

The scope of C&M is being enlarged to include all phases of highway engineering and maintenance operations, rather than dealing primarily with construction and maintenance. Since construction and maintenance are an important part of the work of the department, these subjects will still occupy a prominent place in the new publication; however, we intend to serve as the medium through which the field and all divisions of the Austin office may conveniently express thoughts, theories, and methods of operations.

To properly convey its new function as a Departmental publication, C&M will change its name to one which will cover all departments. The new name hasn't been selected at this time.

In the future, we shall hope to receive the same high-quality material from the field, and will invite any material from the Austin office divisions.

* * *

About the Cover . . .

The new Houston District Office, pictured on the cover this month, is one of the most modern and streamlined District Offices in the state.

This building, together with laboratory, shops, and warehouses, was completed in 1952 and is located on fifteen acres of ground in the west part of Houston.

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Construction and Maintenance Bulletin

The purpose of the *Construction & Maintenance Bulletin* is to furnish a medium for presenting practical information applicable to current highway problems. These conclusions and data are not necessarily endorsed by the Highway Department nor are they to be construed as instructions. Employees are invited and urged to submit suggestions and relate experiences which would benefit those engaged in the construction and maintenance of highways.

Photographic services are available and other assistance may be obtained, if desired, in preparing material for submission. All material and comments should be directed to the Chief Engineer, Construction and Maintenance, Austin 14, Texas.

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PUBLISHED JOINTLY BY

Maintenance Division .... D- 3
Equipment & Procurement Division .... D- 4
Construction Division .... D- 6
Traffic Services Division D-16

COMPILED AND EDITED

Traffic Services Division, INFORMATION SECTION

REPRODUCED

Operations Division, REPRODUCTION SECTION

As We See It

The difference between driving safely and recklessly is just a few minutes. That's all that can be saved by breaking or loosely interpreting the rules of the road.

A handy guide for minimum safe distance in following another vehicle—under good driving conditions—is your speed: 30 miles per hour, three car lengths; 40 you need four; 50, five.

Unfortunately, strict observance of traffic rules and regulations is not sufficient for complete driving safety. Good drivers are courteous and considerate. They drive defensively—as though other drivers were irresponsible.

Weed Burner

Milton Hayes, Senior Maintenance Superintendent
District 20

District 20 is using a weed burner which was constructed by shop forces under the supervision of O. A. Keith, Equipment Supervisor. This equipment consists of an air-cooled motor, blower, and burner, mounted on a turret or turntable. This is mounted on a two-wheeled trailer pulled by a small tractor. Diesel fuel is used, furnished to the burner from two 55-gallon drums mounted on the trailer.

The burner unit can be rotated on three-fourths turn and adjusted for height. The flame from the blower or burner head will cover about a five-foot width while burning.

Under average conditions, the burner head is carried about one foot above the ground, but this will vary with vegetation and wind conditions. Travel speed of the burner is determined largely by vegetation conditions, but is in the range of two to six miles per hour.

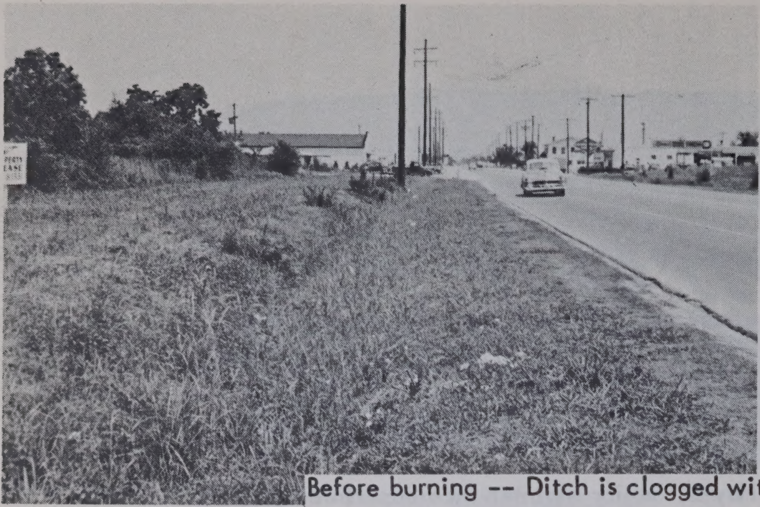
There are two ways to burn vegetation. When burning green vegetation, the recommended method is to make the first trip as fast as can be done and still secure a good kill. A clue to this is provided by the fact that the vegetation, normally a dark green color, takes on a greasy, light green color when it is heated enough to kill it.

From two to ten days after the first burn, the second burn is made to consume the dead vegetation. Weather conditions following the first burn will determine the length of time until the second burn. The first trip on green vegetation can be made in damp weather, even in a light rain, but on the second trip the dead vegetation must be thoroughly dry to get satisfactory results. The secret of economical weed burning is to kill the vegetation the first trip - not to consume it. The second trip is made to consume the vegetation after the sun has dried it out thoroughly.

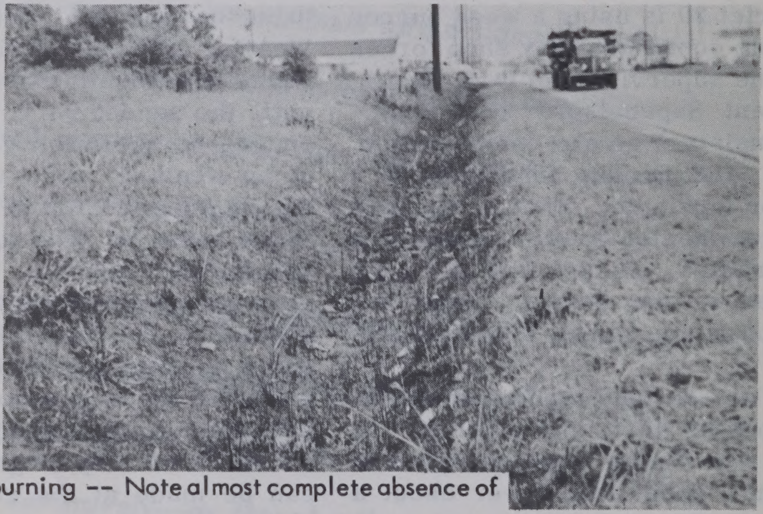
The first trip on green vegetation can be made at the rate of approximately two miles per hour. The second trip can be made at approximately six miles per hour, using an average of about 50 gallons of fuel per hour.

In the lower, or south end of District 20, the growth of vegetation is very rank. First we cut the vegetation, then by mechanical rake move the vegetation into the bottom of the ditch, after which the burner moves in and consumes the dead growth. This method of destroying weeds not only keeps the flow line of the ditches clean for free flow of drainage, but also saves considerable time in remowing as the dead weeds and grass are not present to clog or choke up the mowers.

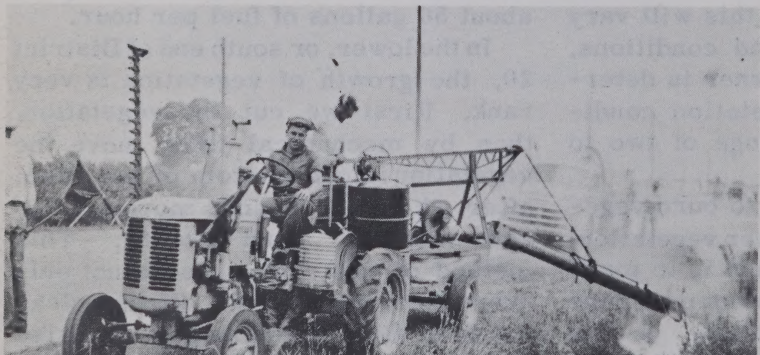
We follow the burner with a water truck to prevent fire from going beyond the rights of way.



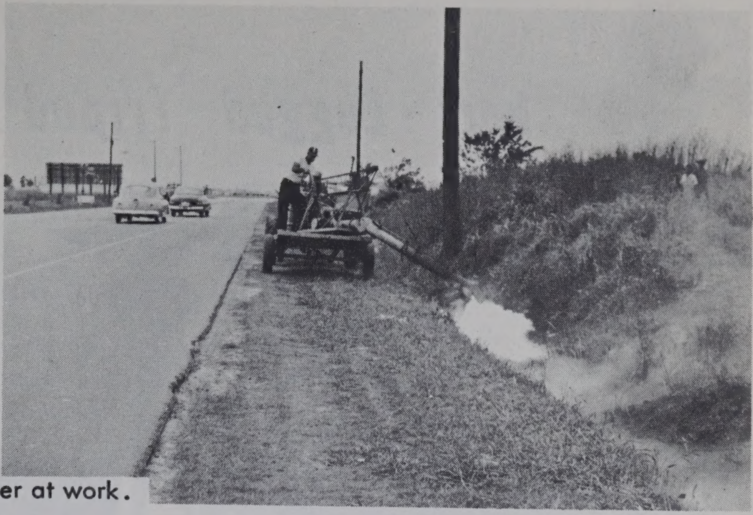
Before burning -- Ditch is clogged with vegetation.



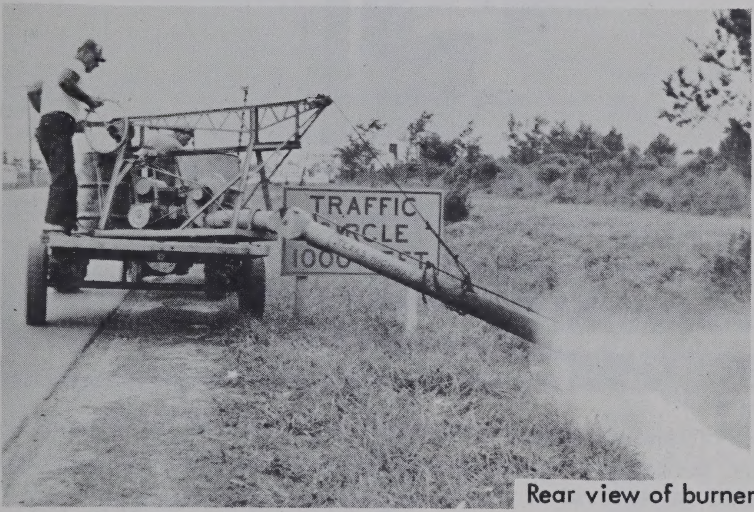
After second burning -- Note almost complete absence of vegetation.



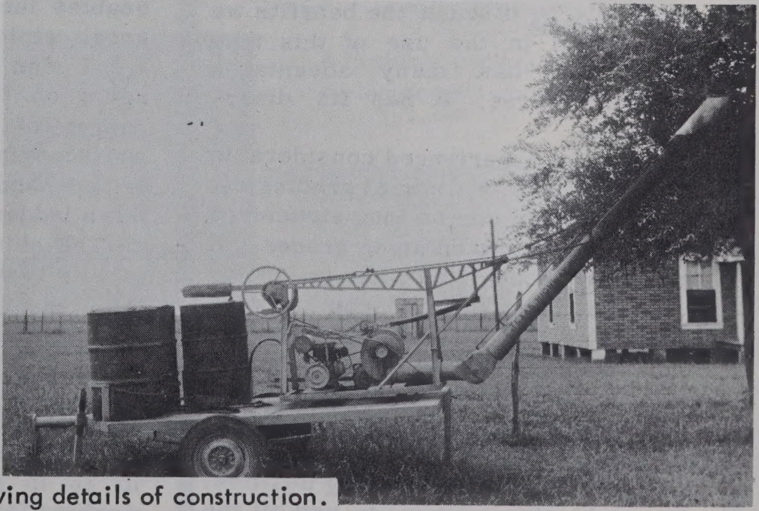
Front view of burner at work. Note water truck in background. Water truck follows burner to prevent fire from getting out of right of way.



Burner at work.



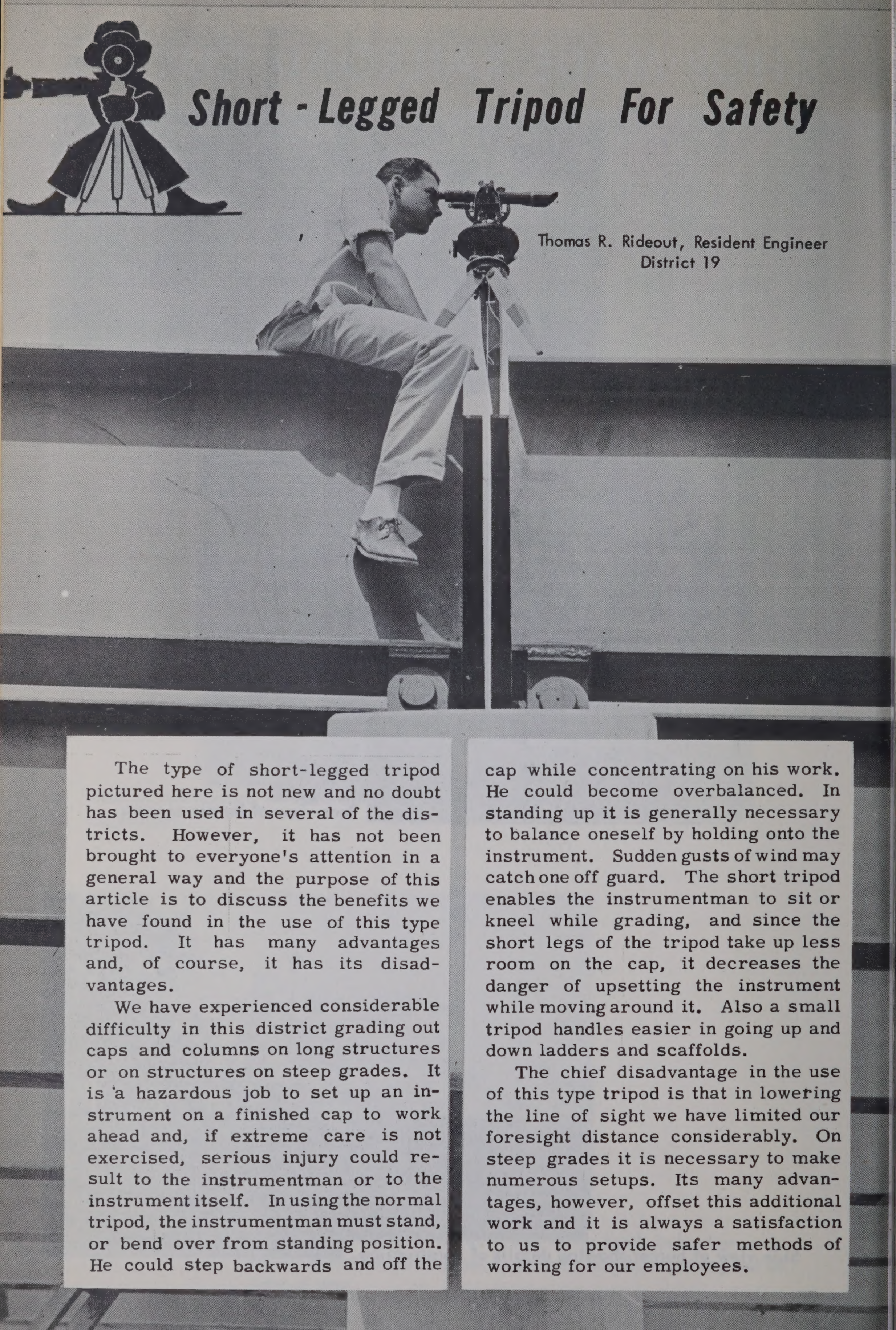
Rear view of burner at work.



Side view of burner showing details of construction.

Short - Legged Tripod For Safety

Thomas R. Rideout, Resident Engineer
District 19



The type of short-legged tripod pictured here is not new and no doubt has been used in several of the districts. However, it has not been brought to everyone's attention in a general way and the purpose of this article is to discuss the benefits we have found in the use of this type tripod. It has many advantages and, of course, it has its disadvantages.

We have experienced considerable difficulty in this district grading out caps and columns on long structures or on structures on steep grades. It is a hazardous job to set up an instrument on a finished cap to work ahead and, if extreme care is not exercised, serious injury could result to the instrumentman or to the instrument itself. In using the normal tripod, the instrumentman must stand, or bend over from standing position. He could step backwards and off the cap while concentrating on his work. He could become overbalanced. In standing up it is generally necessary to balance oneself by holding onto the instrument. Sudden gusts of wind may catch one off guard. The short tripod enables the instrumentman to sit or kneel while grading, and since the short legs of the tripod take up less room on the cap, it decreases the danger of upsetting the instrument while moving around it. Also a small tripod handles easier in going up and down ladders and scaffolds.

The chief disadvantage in the use of this type tripod is that in lowering the line of sight we have limited our foresight distance considerably. On steep grades it is necessary to make numerous setups. Its many advantages, however, offset this additional work and it is always a satisfaction to us to provide safer methods of working for our employees.

SHOP-MADE RAILROAD CURVES

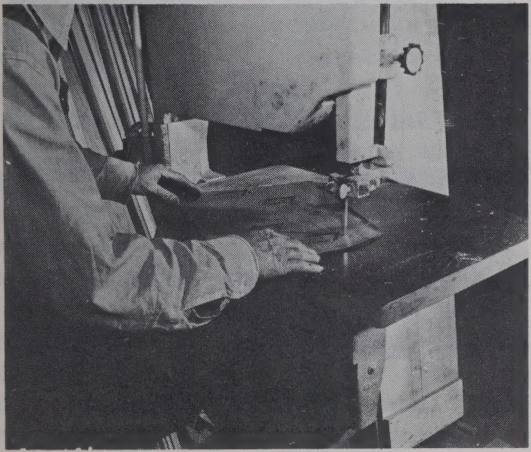
E.J. Owens, Shop Foreman
District 1

Sixteen sets of railroad curves, twelve curves per set, were constructed in the District Shop from Plexiglas.

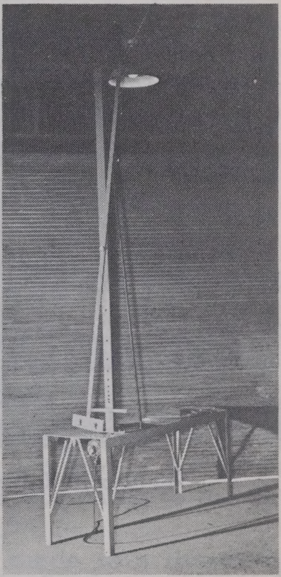
The outline of the curve was drawn on the masking paper the plexiglas is covered with when purchased. This paper was not removed until all operations of constructing the curves were completed.

The curves were cut to the outlines drawn on the paper by using a band saw. They were then adjusted to a true radius by using a pendulum arrangement to swing across an emory wheel.

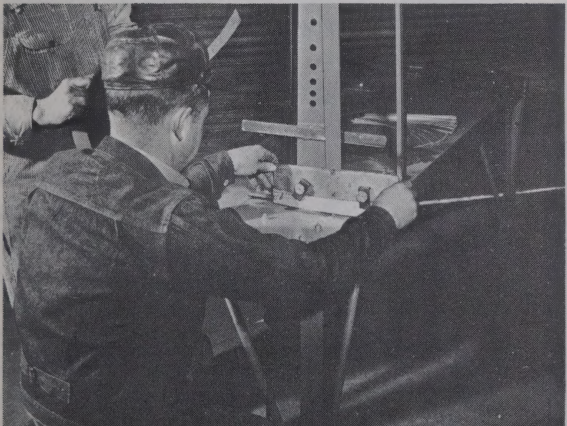
The curves were heated by placing in glass beads at a temperature of 180 degrees to soften enough that the degree of curvature could be stencilled on the curve.



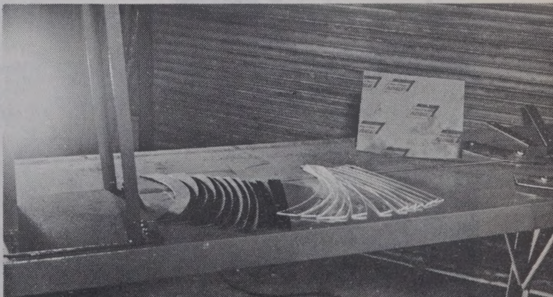
Cutting out curves on a band saw.



Adjustable pendulum arrangement for securing correct curvature on curves.



Final adjustment of curvature on curves.



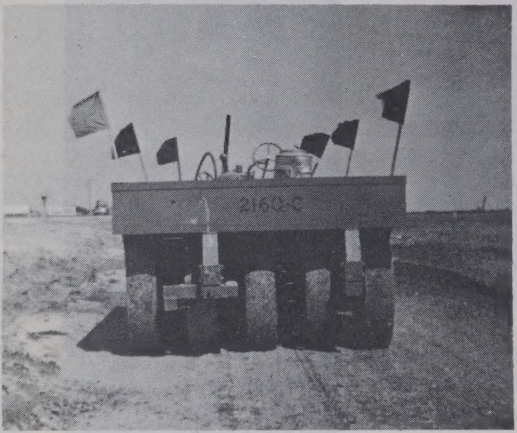
Completed curves, before and after removing masking paper.

FLAGS ON EQUIPMENT

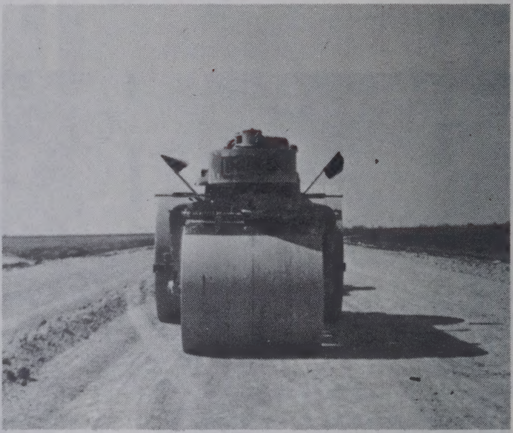
R. N. Jennings, District Maintenance Engineer
District 7

These pictures illustrate the generous use of red flags on state equipment working on and along roads in District 7.

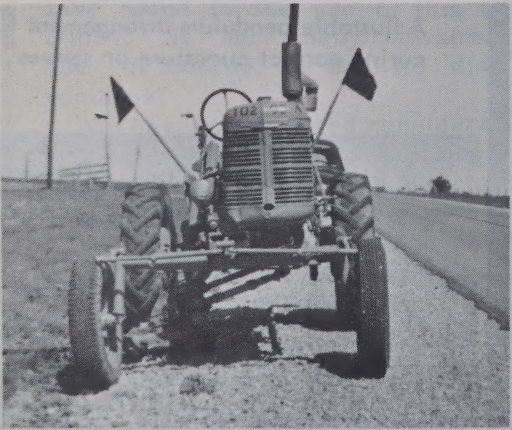
The fluttering of the red flags, moved by the wind or speed of the vehicle provides a warning to the motorist that the yellow color of the equipment alone, does not offer.



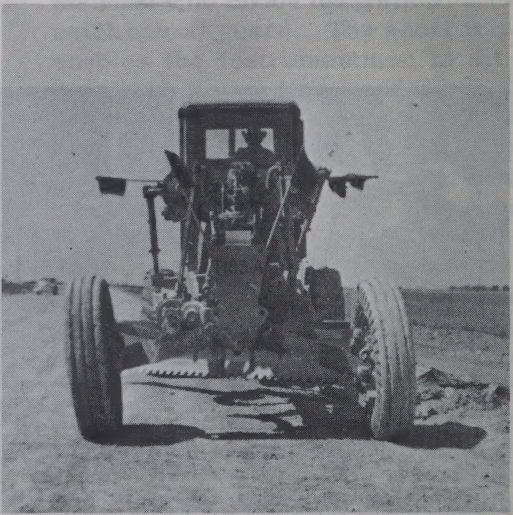
Pneumatic Roller



Flat Wheel Roller



Mower



Motor Grader

Special BOLT THREADING ATTACHMENT

Willie Coleman, Construction Foreman
District 19

The following is an explanation of the manner of threading bolts with a new attachment for operation with a winch truck.

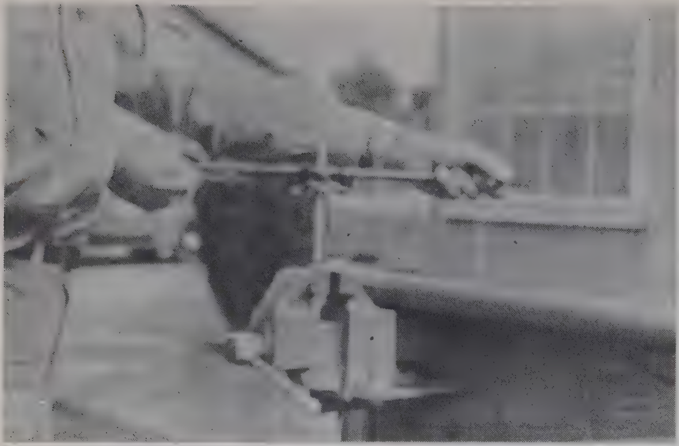
In the past this District, like many of the other districts, has had to thread bolts in the field by use of a vise and a die operated by hand. This method is very slow and restricted to small size bolts.

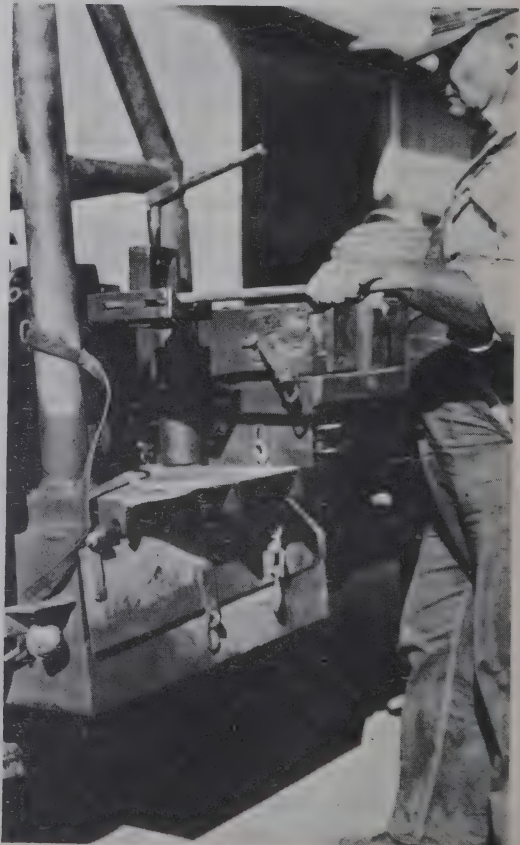
To improve this method, our bridge crew provided a labor-saving device by attaching the die stock to one end of the cathead of a winch. The power take-off of the truck turns the cathead (independent of drum by throwing the dog in and out), at a very slow and regular speed. By inserting a bolt held by a Stillson wrench, several inches of thread can be put on the end of the bolt in a short time. This saves considerable labor, but it is necessary that a man hold the bolt with a Stillson wrench and move the wrench forward as the bolt feeds into the die. The wrench is then reversed as the cathead of the winch is turned backward to release the bolt.

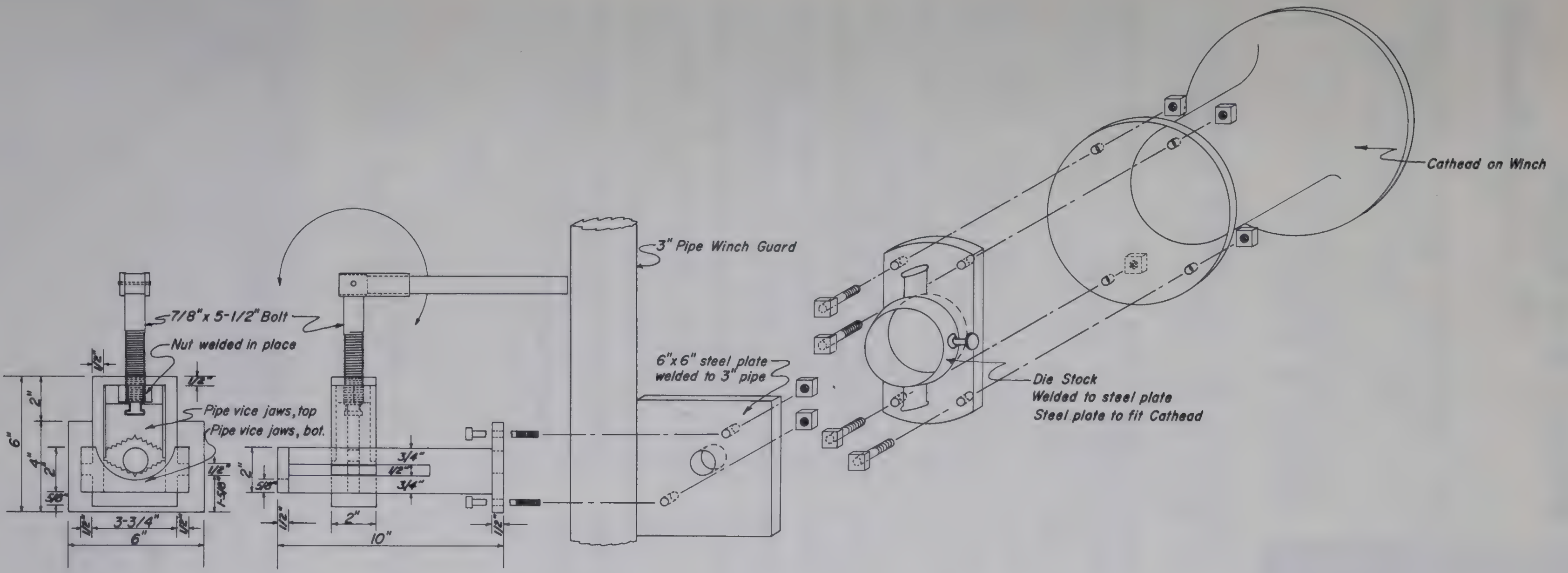
A further development has now been made in this bolt-threading operation by fixing a plate on the headache post near the end of the cathead. To this plate is attached a portable apparatus which we call a movable vise. This vise holds the bolt in the proper place and will slide forward as the bolt is fed into the die. When the cathead is reversed, the movable vise will slide backward as the bolt is released from the die. The operator merely inserts a bolt into the device, fixes it into place by the screw-type holding mechanism such as used in an ordinary pipe vise, starts the winch turning, and allows the bolt to be threaded up to four inches if necessary; then by reversing the winch, the bolt is backed out of the die. Bolts from one-fourth to one and one-half-inch size can be threaded in the device and the size needed will determine the die stock to be used for attaching to the cathead of the winch.

We have made this threading attachment a part of the winch truck used by the bridge crew and have found it to be of great service to us in threading the many one-inch bolts used in our bridge-widening operations.

By referring to the first picture, you will note the old method of using the vise and die set in which the operation is all manual. The second picture shows the winch doing the actual threading with operator holding the Stillson wrench in order to get an evenly cut thread. The remaining pictures show our present adaption of the movable vise and the ease with which bolts can be threaded.







TEXAS HIGHWAY DEPARTMENT
DISTRICT 19
VICE AND WINCH POWERED BOLT THREADER
Scale 3/8" = 1"

Portable Crusher

For Oversize Base Material

R.L. Lee, Senior Maintenance Foreman
District 10

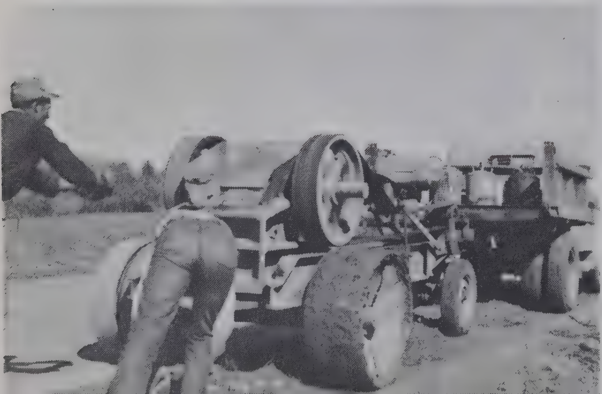
In trench widening, narrow pavements with iron base utilization of oversize material is usually a problem. The narrow width prevents the use of a sheepsfoot or grid roller, while wasting the oversize stones reduces the quality of the base material.

Several years ago, the District Shop at Tyler rigged up two crushing units designed by T.A. McBride, to handle this oversize material. These units were used to advantage on full-width base jobs before we acquired a grid roller, as well as on trench widening.

A ten-inch by fourteen-inch Cedar Rapids Jaw Crusher, powered by an A.C. Model B Farm Tractor motor is mounted on a shop-built chassis. Dual 6.50 x 20 tires on the rear are used when transporting the unit. The outside rear tires are removed and replaced by steel wheels to reduce vibration when the crusher is operating.

Normally, two trips with the crusher are sufficient. After the loose material has been spread in the trench, the oversize material windrowed on the shoulder is picked up and put through the crusher. Additional oversize material is dragged out when the material is scarified and part of it pulled out on the shoulder for compaction of the lower half. When the loose material in the upper half is pulled back into the trench, the crusher makes another trip to take care of the oversize stones. The crushed material is spread uniformly with a blade and worked into the base by scarifying and blading ahead of the final rolling.

Oversize stones which could not be worked into the base are fed to the crusher, which reduces them to usable size.



The crushed material is ready to be spread, scarified, and incorporated in the base.

BUILDING UP SETTLED FLEXIBLE BASE WIDENING STRIPS ALONG RIGID PAVEMENT

Gilbert Bass, Senior Maintenance Foreman
District 10

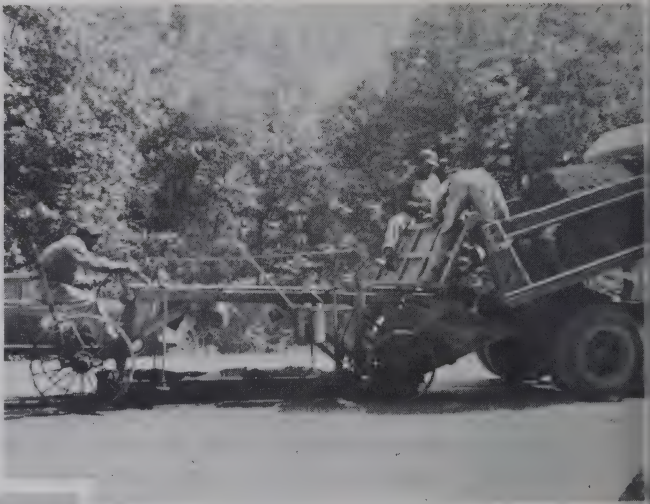
Our customary method of widening narrow pavements in this district is placing iron ore gravel base nine or ten feet in depth in a trench cut alongside the pavement. The width of the trench varies with the width of the original pavement to provide a usual over-all width of 25 or 26 feet.

The base in this trench is surfaced with a prime coat and single asphalt surface flush with the existing pavement. When flexible bases are widened in this manner, we seldom have any appreciable settlement of the base in the trench. On concrete pavements, however, some settlement usually develops due to the difficulty of securing thorough compaction of the material in the trench along the rigid slab. For this reason, we prefer to maintain this trench widening under traffic for two or three years, serving as a surfaced transition strip between the edge of the slab and the sod shoulder. When settlement occurs, the surface is brought back flush with the slab with rock asphalt or cold-laid asphaltic concrete. The pavement can then be resurfaced with asphaltic concrete 24 or 25 feet wide without undue further settlement developing in the trench.

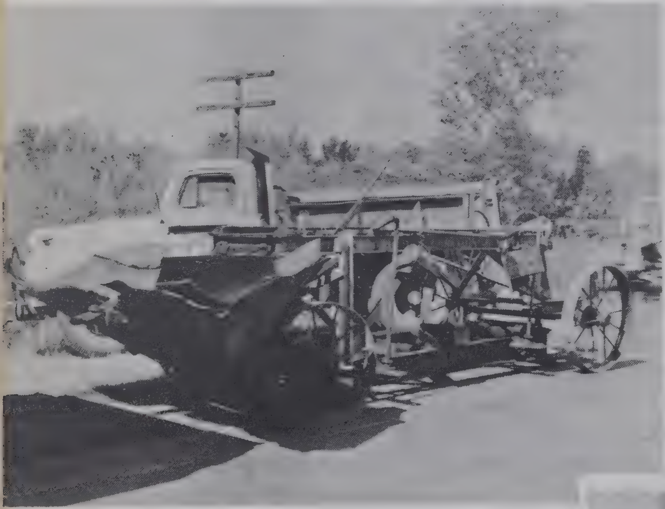
Placing and distributing the material by hand methods to build up these settled edges is slow and expensive. Some years ago a device for placing this material mechanically was developed and built in the District Shop at Tyler. A spreader was built from the chassis of an old Stockton mule-drawn grader. It is pulled behind the loaded truck, from which the material dumps into a hopper with an adjustable outlet. The material is spread evenly by four blades set at alternating angles and a fifth blade at right angles mounted between two channel irons. This spreader is suspended from the frame overhead, so that it can be raised or lowered to place the proper amount of material to allow for compaction. Interchangeable slides of various widths allow the material to be placed the desired width.

The spreader is followed by motor graders and a pneumatic roller, and final compaction is secured by several rounds with a heavy three-wheel roller.

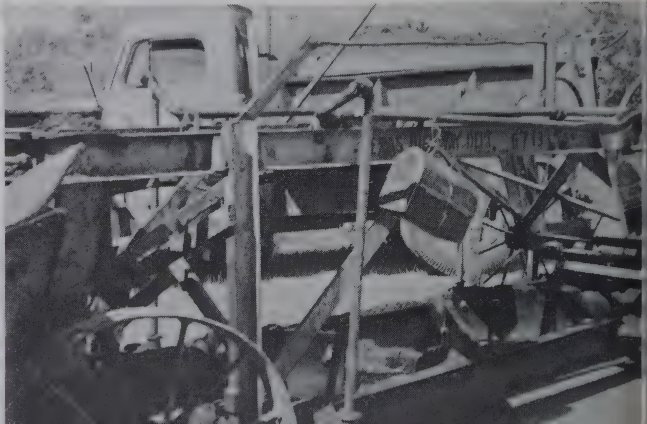
1. Applying tack coat to the settled strip.



2. Placing material with special spreader used in the Tyler district.



3. Close-up of spreader hopper.



4. Four blades set at angles provide uniform spread. The spreader box may be raised or lowered for proper depth.

5. Motor graders following spreader.

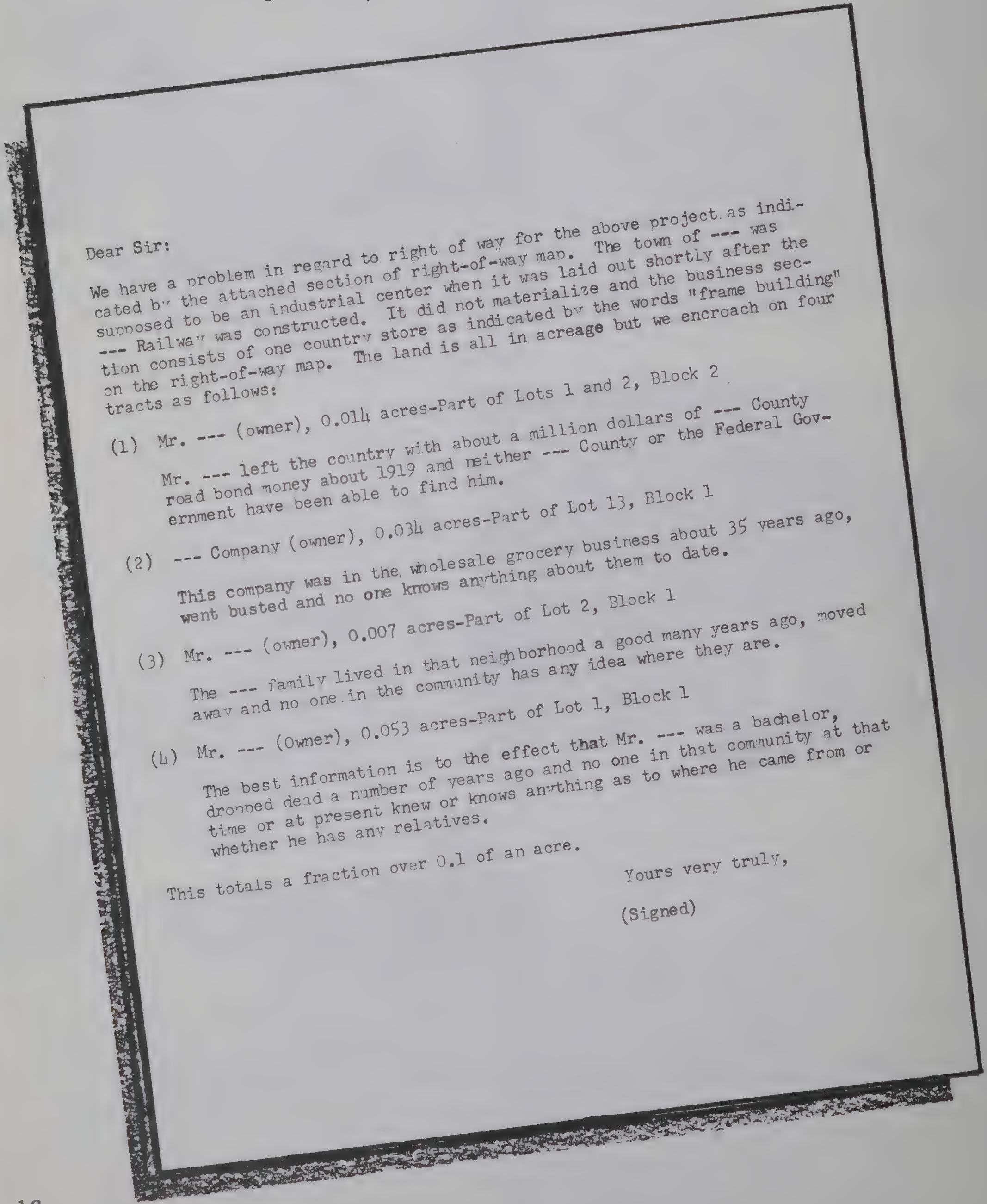
6. Pneumatic roller compacts material behind blades.

7. Flat wheel roller provides final com paction.

8. Completed job -- flush with slab.

So You Think You've Got Troubles...

This letter shows just how much can be involved in obtaining one-tenth of an acre for right of way.



Dear Sir:

We have a problem in regard to right of way for the above project as indicated by the attached section of right-of-way map. The town of --- was supposed to be an industrial center when it was laid out shortly after the --- Railway was constructed. It did not materialize and the business section consists of one country store as indicated by the words "frame building" on the right-of-way map. The land is all in acreage but we encroach on four tracts as follows:

(1) Mr. --- (owner), 0.014 acres-Part of Lots 1 and 2, Block 2

Mr. --- left the country with about a million dollars of --- County road bond money about 1919 and neither --- County or the Federal Government have been able to find him.

(2) --- Company (owner), 0.034 acres-Part of Lot 13, Block 1

This company was in the wholesale grocery business about 35 years ago, went busted and no one knows anything about them to date.

(3) Mr. --- (owner), 0.007 acres-Part of Lot 2, Block 1

The --- family lived in that neighborhood a good many years ago, moved away and no one in the community has any idea where they are.

(4) Mr. --- (Owner), 0.053 acres-Part of Lot 1, Block 1

The best information is to the effect that Mr. --- was a bachelor, dropped dead a number of years ago and no one in that community at that time or at present knew or knows anything as to where he came from or whether he has any relatives.

This totals a fraction over 0.1 of an acre.

Yours very truly,

(Signed)

Tie New Equipment Rental System Into Your P.M. Program

J.L. Heim Jr., Assistant Director
Equipment and Procurement Division

The control and adjustment of equipment rental rates at District level, in my opinion, will in the near future bring about certain changes in so far as the need and use of equipment is concerned and will also have a direct bearing on the Districts' present preventive maintenance program.

For a District to stay within the minimum and maximum amounts allowed for profit or loss, individual equipment records may be maintained to determine which unit or class of equipment is producing the most rental. From such records it will be noted that equipment listed under Code Chart 24-A will produce approximately 20 per cent and equipment listed under Code Chart 24-B will produce approximately 80 per cent of the total equipment rental. To obtain this information, the District may accumulate monthly the total hours, miles, or months used, total expense, rental and profit or loss from the Monthly Equipment Expense and Rental Tabulation furnished by D-11. For example, see Cut A for form that will be used by D-4 to record necessary information on all equipment assigned to Camp Hubbard.

Within six months the District should have at least four months' information on each unit of equipment and should be able to determine which units are operating at a profit or loss. At this point, equipment operation ties in directly with your present preventive maintenance program.

Office records such as work orders, warehouse stock payrolls, and Monthly Equipment Expense and Rental Tabulation may be analyzed to see if the loss was due to extensive or unusual repairs as compared to use and need of equipment. The analysis may also show that like equipment received and placed in operation the same date, working the same hours under approximately the same working conditions may be operating for a profit in Section A and for a loss in Section B.

From the above information obtained, it may be necessary to make a field inspection to determine the reason for down time or equipment loss which could be caused from defective equipment, inexperienced or negligent operators, or lack of preventive maintenance. Likewise, equipment operating at a profit points directly to a good operator and a well-planned preventive maintenance program. For example, two trucks are received and assigned by the

District to foremen of Section A and B. The foreman in Section A enforces a rigid preventive maintenance program, requires equipment to be washed, greased, oil changed, battery, lights, ignition system, etc. to be checked at regular intervals based on miles or hours of operation. When equipment is placed in storage, a thorough check is made to see that the unit is ready to operate when needed.

In Section B, the foreman does not enforce a preventive maintenance program as rigidly as the foreman in Section A. In this case the operator may or may not wash, grease, change oil, and check other items at regular intervals. If this type of equipment maintenance continues, you can readily see that future repair cost on trucks in Section B will be, in most cases, higher than repair cost on trucks assigned to Section A.

From the above comparison, it appears that the individual equipment cost record will pinpoint equipment operation, excessive down time, excessive repairs, and the use and need for equipment. A good operator's work will stand out, and the District can compensate or reward the operator in Section A with a lower rental rate, while making the inefficient operator in Section B pay for his operation. The individual rental rate adjustment between Sections could bring equipment operation in line with efficient methods.

Under the new Rental Adjustment System, revealing facts may be called to the attention of the Districts in the same manner as were revealed when equipment rates were adjusted by the main office. For example, when the main office was controlling rental rates, they varied at times by Districts from 30 per cent over base to 30 per cent under base rates. Present rental rates, effective May 26, 1953, for equipment classified under Code Chart 24-B. (See Cut B) vary by Districts from 10 per cent over base to 25 per cent under base rates.

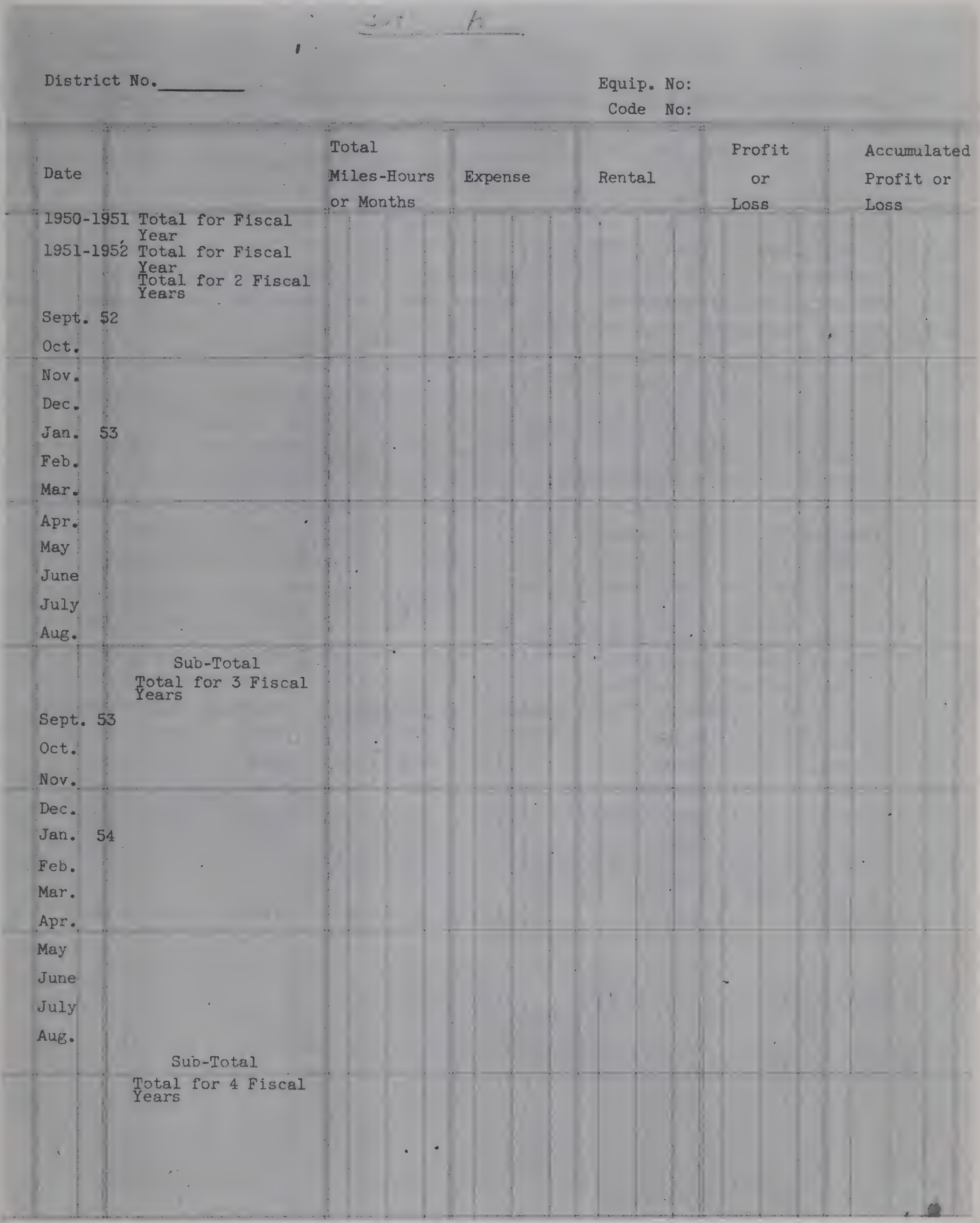
The profit and loss for each District as of June 25, 1953, is listed below for comparison with District rental rates.

PROFIT AND LOSS BY DISTRICTS
AS OF JUNE 25, 1953

DISTRICT	AMOUNT	DISTRICT	AMOUNT
1	1,384.44	14	41,182.72
2	22,661.38	15	20,284.39
3	- 14,680.72	16	27,330.08
4	2,310.70	17	3,258.57
5	27,913.49	18	20,303.51
6	- 4,843.54	19	- 6,722.59
7	20,907.38	20	705.98
8	12,523.88	21	15,417.46
9	- 22,031.06	22	16,000.07
10	34,033.71	23	9,823.31
11	4,082.79	24	- 2,597.67
12	2,731.81	25	26,282.72
13	17,019.87	TOTAL PROFIT	259,726.82

From the comparison, Districts 1, 2, 3, and 24 are on base rates and District 2 shows a profit while Districts 1, 3, and 24 are operating at a loss. Under the old system, it would be necessary for the main office to raise rental rates in Districts 1, 3, and 24, and lower rates in District 2.

In conclusion, it is believed that if rental rates are adjusted in individual units or by sections, the efficiency of our state-wide equipment operation can be increased.



District No.________

Equip. No:
Code No:

Date		Total Miles-Hours or Months	Expense	Rental	Profit or Loss	Accumulated Profit or Loss
1950-1951	Total for Fiscal Year					
1951-1952	Total for Fiscal Year					
	Total for 2 Fiscal Years					
Sept. 52						
Oct.						
Nov.						
Dec.						
Jan. 53						
Feb.						
Mar.						
Apr.						
May						
June						
July						
Aug.						
	Sub-Total					
	Total for 3 Fiscal Years					
Sept. 53						
Oct.						
Nov.						
Dec.						
Jan. 54						
Feb.						
Mar.						
Apr.						
May						
June						
July						
Aug.						
	Sub-Total					
	Total for 4 Fiscal Years					

CODE CHART 24-B, CLASS OF

EFFECTIVE

Code No.	Description	Base Rate	5% Over	10% Over	15% Ov
18-1	Automobile, Chevrolet	$ .045 Mi.	$ .047 Mi.	$ .05 Mi.	$ .052
18-7	Automobile, Ford	.042 "	.044 "	.046 "	.048
568-1	Maintainer, Gasoline, 69 H. P. or less	1.80 Hr.	1.89 Hr.	1.98 Hr.	2.07
568-5	Motor Grader, Diesel, 70 H. P. Thru 99	2.60 "	2.73 "	2.86 "	2.99
568-7	Motor Grader, Diesel, 100 H. P. and Over	3.30 "	3.47 "	3.63 "	3.80
624	Mower, Tractor, Highway	1.30* "	1.37* "	1.43* "	1.50*
715-2	Power Shovel or Dragline, 1/2 or 5/8 Yd.	4.80 "	5.04 "	5.28 "	5.52
715-3	Power Shovel or Dragline, Truck Mounted, 3/8 to 5/8 Yd.	6.00 "	6.30 "	6.60 "	6.90
716	Power Shovel, or Dragline, 3/4 Yd. and Over	6.10 "	6.41 "	6.71 "	7.02
900-5	Tractor, Crawler, Diesel, 60 to 80 H. P.	4.70 "	4.94 "	5.17 "	5.41
904-1	Tractor, Front End Loader, Track Type Over 1/2 Yd.	4.00 "	4.20 "	4.40 "	4.60
904-3	Tractor, Front End Loader, Wheel Type, Less 3/4 Yd.	2.30 "	2.42 "	2.53 "	2.65
904-4	Tractor, Front End Loader, Wheel Type, 3/4 Yd. and Over	3.00 "	3.15 "	3.30 "	3.45
915	Truck, Station Wagon Body, Carryall or Power Wagon	.06 Mi.	.063 Mi.	.066 Mi.	.069
916-2	Truck, Pickup Body	.048 "	.05 "	.053 "	.055
930-1	Truck, 2 Ton, Ford	.084 "	.088 "	.092 "	.097
930-2	Truck, 2 Ton, Chevrolet	.08 "	.084 "	.088 "	.092
930-3	Truck, 2 Ton, International	.09 "	.095 "	.099 "	.104
930-4	Truck, 2 Ton, Dodge	.091 "	.096 "	.10 "	.105
930-5	Truck, 2 Ton, All other Makes	.106 "	.111 "	.117 "	.122
931	Truck, Over 2 Ton and less than 5 Ton	.18 "	.189 "	.198 "	.207

* On items marked (*) the 40 hour minimum does not apply from October to March, inclusive, but is in effect from April to September, inclusive.	1 2 3 24	6 7 25	9 12 16

UIPMENT WITH RENTAL RATES

Y 26, 1953

5% Less	10% Less	15% Less	20% Less	25% Less	30% Less
$ .043 Mi.	$ .041 Mi.	$ .038 Mi.	$ .036 Mi.	$ .034 Mi.	$ .032 Mi.
.04 "	.038 "	.036 "	.034 "	.032 "	.029 "
1.71 Hr.	1.62 Hr.	1.53 Hr.	1.44 Hr.	1.35 Hr.	1.26 Hr.
2.47 "	2.34 "	2.21 "	2.08 "	1.95 "	1.82 "
3.14 "	2.97 "	2.81 "	2.64 "	2.48 "	2.31 "
1.24* "	1.17* "	1.11* "	1.04* "	.98* "	.91* "
4.56 "	4.32 "	4.08 "	3.84 "	3.60 "	3.36 "
5.70 "	5.40 "	5.10 "	4.80 "	4.50 "	4.20 "
5.80 "	5.49 "	5.19 "	4.88 "	4.58 "	4.27 "
4.47 "	4.23 "	4.00 "	3.76 "	3.53 "	3.29 "
3.80 "	3.60 "	3.40 "	3.20 "	3.00 "	2.80 "
2.19 "	2.07 "	1.96 "	1.84 "	1.73 "	1.61 "
2.85 "	2.70 "	2.55 "	2.40 "	2.25 "	2.10 "
.057 Mi.	.054 Mi.	.051 Mi.	.048 Mi.	.045 Mi.	.042 Mi.
.046 "	.043 "	.041 "	.038 "	.036 "	.034 "
.08 "	.076 "	.071 "	.067 "	.063 "	.059 "
.076 "	.072 "	.068 "	.064 "	.06 "	.056 "
.086 "	.081 "	.077 "	.072 "	.068 "	.063 "
.086 "	.082 "	.077 "	.073 "	.068 "	.064 "
.101 "	.095 "	.09 "	.085 "	.08 "	.074 "
.171 "	.162 "	.153 "	.144 "	.135 "	.126 "
5	4	8	20	14	
13	10	11	22		
15	17	21			
	18	23			
	19				

LIME-STABILIZED FLEXIBLE BASE IN JOHNSON COUNTY

Otis L. Robinson, Resident Designer
District 2

With the ever-increasing shortage of base material in many localities, the highway engineer of today is often faced with the problem of producing an acceptable base material from materials which would be considered very unsuitable in their natural state. Sometimes the engineer improves the material by "scalping," which is the removal of portions of the material such as clay or foreign material which may be affecting the soil constants of the material and causing it to fall out of the specification requirements. In other instances the engineer may have to add blow sand in order to reduce the plasticity index of the material or increase the amount of soil binder. Cement or asphalt is usually used to stabilize a material having a low metal content. In the last few years the Texas Highway Department has introduced the use of lime in a few special cases where none of the above-mentioned admixtures would give satisfactory results.

Our first experience with lime-stabilized base in Johnson County was encountered recently on State Highway 174, from Joshua to Burleson. This project, completed July, 1953, consisted of two lanes, each having a 24 foot double asphalt surface treatment. The triaxial compression test method was used in designing the thickness of the subgrade and flexible base in order to get a combination of both which would pass the stability test for a 16,000 pound wheel load. Samples of material from proposed roadway cuts were taken and triaxial compression tests were made on these materials. There were four sandy hills on the job which had to be cut through. Triaxial tests on portions of the material from these cuts showed that the excavated material would serve as a good subgrade material which would require approximately ten inches of flexible base on top of it. At this time we had already reached the conclusion that there was no gravel in this locality which would make a satisfactory base material, and it was obvious that we were going to have to use crushed limestone rock as a base. Since we knew that the cost of the base was going to be a major item in the cost of the job, we set out to obtain a subgrade material over the entire job which would not require more than ten inches of base. On our plans we set up the sandy material from the roadway cuts as reserve select material; however, this was enough material for only a small portion of the job and it was necessary to find a borrow source from which we could get enough select material to build subgrade for the remaining portion of the job. Fortunately, a source of sandy loam was found not more than two hundred feet from the right of way, which we decided to use for select material. A depth of six to eighteen inches of this material was necessary to meet the triaxial requirements and still hold our base to a depth of ten inches.

After we had satisfied ourselves

we had a subgrade that would meet all requirements, we were faced with the problem of finding or producing a flexible base that would meet the specification requirements. The surrounding locality was thoroughly searched and all possible sources of material of any type were cored with the coring machine. After several weeks of searching for base, we decided we would have to use a limestone rock pit six miles west of the job. Our core tests showed that this rock had many clay seams in it, but it was still better than the other sources drilled in that locality. Samples of this material were taken by the District 2 Laboratory, and soil tests and triaxial compression tests were made on the raw material. The tests showed the plasticity index of the raw material averaged from 15 to 18 and the liquid limit was around 34. An admixture of 7 per cent blow sand was tried with the raw material. This produced a material having 36 per cent soil binder, a liquid limit of 28 and a plasticity index of 14. The triaxial compression test showed that the material with sand added was of Class 3.2, while the raw material was of Class 2.9. Further tests proved that additional sand would lower the plasticity index below the allowable maximum of 12, but in so doing, we would reduce the quality of the material as tested by the triaxial method. Also an additional amount of sand would have increased the soil binder content of the material to almost 40 per cent, which is usually the maximum allowed for a base on a primary project in our district. Tests were then made on the material with varying percentages of hydrated lime being added. From these tests we found that, by adding 3 per cent lime by weight, we would obtain a material with a plasticity index of about 8 or 9, liquid limit of about 35, and a soil binder content of 30 to 33 per cent. Triaxial compression tests on this mixture showed that we had a class 1 material with a stability capable of carrying a 16,000 pound wheel load. Two per cent lime would give almost as good results as 3 per cent, but after giving it considerable thought, we decided to hold the lime to 3 per cent in order to get a more uniform mix.

We were fortunate in having the Cleburne Limestone Products Company located only thirteen miles from the material source and, after talking with the officials of this company, we learned that they could produce hydrated lime and deliver it to the rock crusher site at a price of $10.50 per ton to the contractor. We then estimated that the lime would cost the State Highway Department about $14 per ton from the contractor. This additional cost would include the contractor's profit on the lime, the cost of a storage bin at the crusher site, and the cost of operating a conveyor unit to carry the lime from the storage bin to the crusher. According to our preliminary estimate, the adding of 3 per cent lime to the base would cost approximately $47,000, whereas, 10 per cent of additional sand binder would cost approximately $8,000. These figures are given to show how much could have been saved if we had been able to use the sand to make the material pass the triaxial tests. Of course, in some localities, lime would probably cost even more than the above-mentioned price if the lime source is located farther from the job site. After convincing ourselves that we could not produce a satisfactory material by adding sand, we then prepared the plans and set the job up as a lime stabilized flexible base job. In July, 1952, the contract was awarded to Cage Brothers of San Antonio. Our preliminary estimate of $14 per ton for the cost of the lime was very close to the average of the eight bidders on the job.

In a special provision to the item of flexible base, we stated that the lime should be evenly incorporated with the base material on the conveyor belt of the crusher at the source during processing operations, so as to provide a uniform product. The contractor erected a storage bin approximately 25 feet from the crusher. In order to unload the lime delivery trucks into the bin, an earth ramp was built for the trucks to back upon. To carry the lime from the storage bin to the conveyor belt of the crusher, the contractor used a screw-type conveyor powered by a small LeRoi engine. We were able to vary the amount of lime incorporated into the base material by increasing or decreasing the speed of the engine; however, for large variations it was necessary to change the size of the pully wheel on the conveyor unit. The storage bin had a capacity of 25 tons based upon a unit weight of 40 pounds per cubic foot of lime. With two trucks hauling approximately nine tons of lime per load and beginning with a full bin of 25 tons each morning, we found it difficult to keep enough lime at the crusher site. This was based on an average output of 2,500 cubic yards of base per day, which required approximately 86 tons of lime. Rather than build a larger storage bin, the contractor chose to convert a 10 cubic yard cable-dump truck into a lime truck by building up the sides and covering the top with metal plating. One of the main reasons for the inability to keep an ample supply of lime at the crusher site was the great amount of time required for a lime truck to unload; the lime was being used almost as fast as a truck could unload it. Another trouble encountered by the contractor was the leakage of the lime from the storage bin. We readily discovered that lime, when kept absolutely dry, would flow almost like water. This difficulty was immediately remedied by caulking all holes and cracks in the bin. Still, the contractor's troubles were not over; neither were the engineer's problems solved. On the second day's run, a strong wind began blowing, and so did the lime. The contractor's men who worked around the crusher were almost blinded from the lime getting into their eyes, causing a burning sensation in the eyes, nostrils, and throat. Finally, the contractor had to furnish his men with small masks which consisted of goggles and an air cleaner which covered the mouth and nose of the wearer. Of course, this did not solve the problem of great loss of lime due to the wind. We then requested the contractor to cover the conveyor belt with heavy canvas and to build a hood to act as a windbreak between the end of the conveyor belt and the truck bed. This greatly reduced the amount of lime lost due to wind since most of the loss occurred when the material fell from the conveyor belt into the truck.

The Highway Department furnished a checker at the lime plant who weighed each truck empty and again after it was loaded. He then issued a ticket (Form No. 124) to the driver, showing the gross weight, tare weight, and net weight. On arrival at the storage bin, the ticket was taken up by another checker, who saw that the load was delivered to the job. In order to see that we were getting the percentage of lime in the base which we desired, it was necessary to keep a running total of the amount of lime used and the amount of base produced from day to day. At the end of every day, we totaled the lime tickets through that day, then subtracted the amount of lime which remained in the bin. The total amount of flexible base hauled through that day was converted from cubic yards into tons. The total tonnage of the base divided into the total tonnage of lime used gave us the percentage of lime used through that day. In order to get the percentage of lime used for only one day, the totals for the previous day were subtracted from those of the following day.

The Highway Department had a field laboratory set up at the material source, and a sample of the base was taken for every 500 cubic yards produced. The plasticity index of the material produced ranged from 8 to 10, which was within the limits of 4 to 12 set up in the specifications as a control. We found that the lime had a tendency to increase the liquid limit of the material six or seven points. This placed the liquid limit in the range from 40 to 42 which was above the maximum allowable of 35 for the project. This could have been reduced by the addition of sand, but as previously stated, this would also lower the quality of the material in regard to its stability. With this in mind, and the fact that we were getting what we considered a good base material, we submitted a field change requesting that the maximum allowable of 35 for the liquid limit be waived. This field change was readily approved. After the first base material which we laid-in had been in place for about one month, we began taking samples from the road. Tests on these samples showed that the liquid limit had decreased approximately two points; this was probably due to the rolling operations or a chemical reaction caused by the lime.

Road operations with this base material were very satisfactory. We found that it worked very similarly to other good base materials which we had used. No difficulty was encountered in wetting, rolling, and shaping the base and, after it had been compacted and cured out for several days, we were able to finish it without any difficulty. Compaction of the flexible base was obtained by the "Controlled Density Method" with the intention of securing a Proctor Density of not less than 100 per cent. The majority of the tests made showed the Proctor Density to be more than 110 per cent.

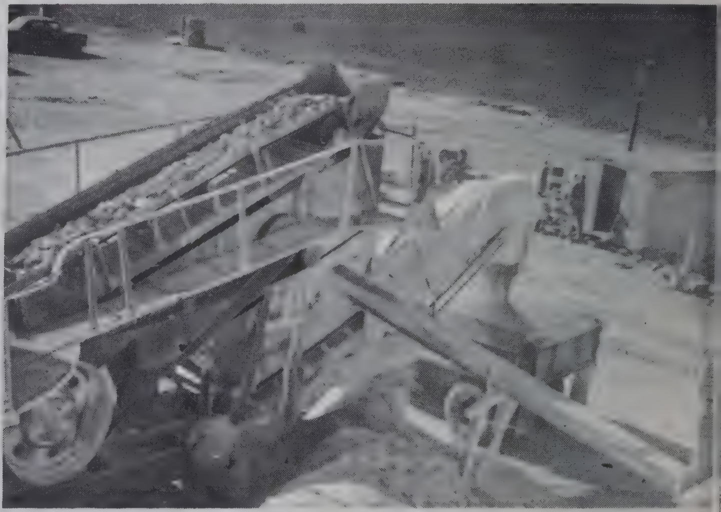
In conclusion, I would say that our first experience with lime-stabilized flexible base in Johnson County has been most satisfactory. Of course, there is a lot to be learned in this field yet, but I hope that this article may have given others a few pointers which may be of help to them if they ever have an occasion to use lime as a stabilizer of flexible base.

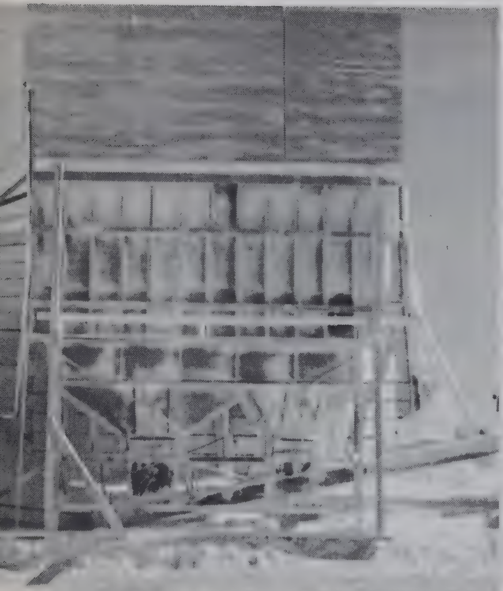
Shovel loading truck in pit.

Pit truck dumping rock onto feeder belt of crusher.

Rock on conveyor belt to primary crushing unit.

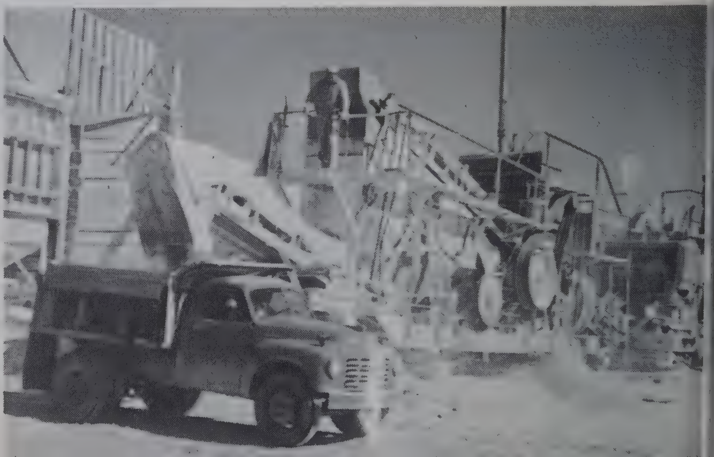
Side view of crusher. Note the screw-type conveyor runs from lime storage bin (lower right) into the side of the crusher.





Lime storage bin with conveyor unit underneath.

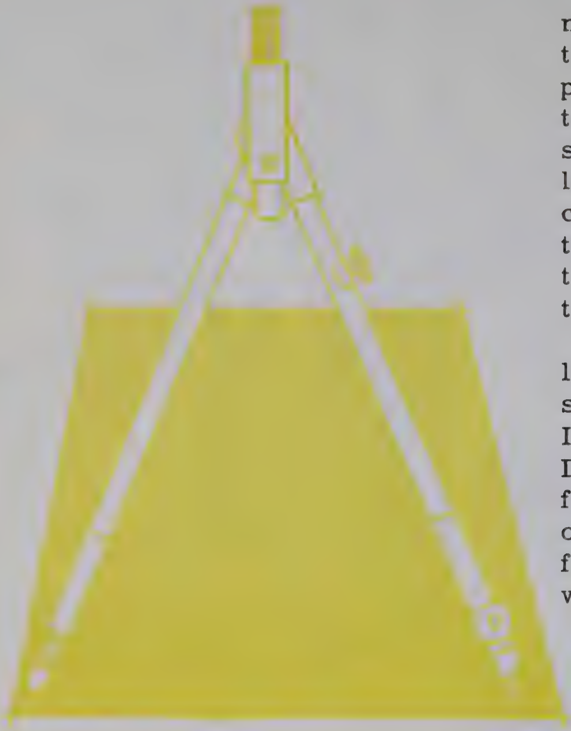
Truck loading from crusher. Note the windbreak where material discharges from crusher into truck.



Dumping lime stabilized base on subgrade.

Shaping lime stabilized base on third day after laying it.

Lime stabilized base ready for final finishing operations.



Sketches For Commercial And Private Driveway Permits

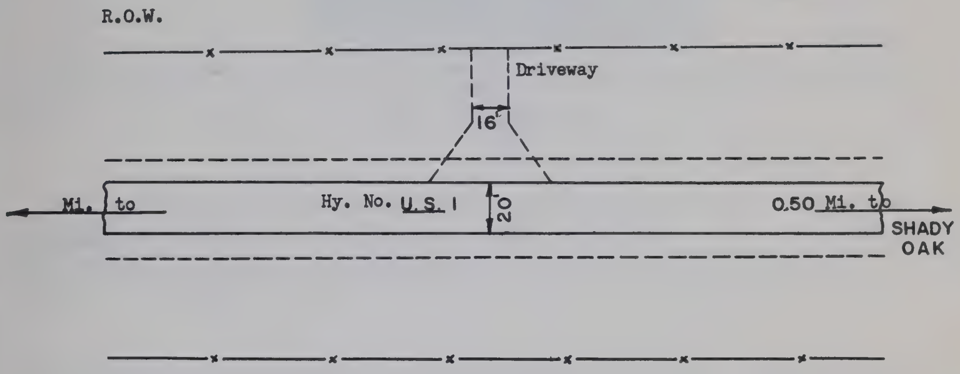
F.M. Davis, District Engineer
District 15

So that the applicant can clearly understand the conditions of a permit, for commercial and private driveways, it has long been a policy of District 15 to show a pencil sketch on the back of the form at the time it is issued. This required considerable time and there was not much uniformity, as sketches varied with different foremen.

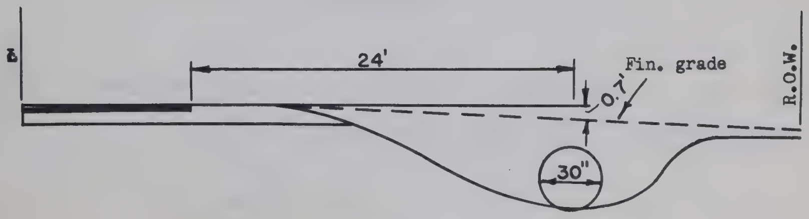
B. R. Wood, Senior Maintenance Foreman at Floresville, recently suggested that basic information be indicated on the reverse side of the forms by some method at the District Office. This then would enable the foreman to insert the necessary data obtained at the driveway site. Wood's suggestion was discussed at a Foremen's meeting and it was decided that the idea was sound and that we should proceed with preparation of a sketch to be studied at a future meeting. The sketch was prepared and indicated a layout, a cross section for both a culvert installation and valley gutter type of entrance. The foremen are to select the type of cross section that would apply.

The sketch was thoroughly analyzed by maintenance foremen and supervisory personnel, and approved. It was then taken to the Operations Division at Austin, who did a very fine job of lithographing on the backs of the permit forms. Maintenance foremen are now using it in the field - with good results.

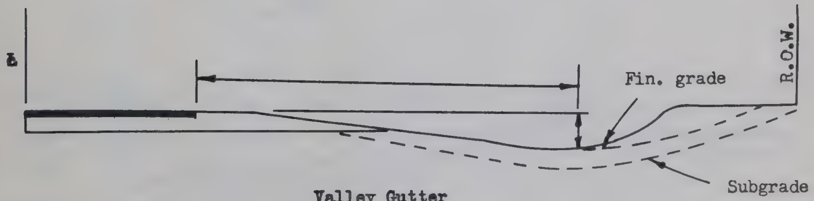
Property Owners Name JOHN DOE



Driveway Layout



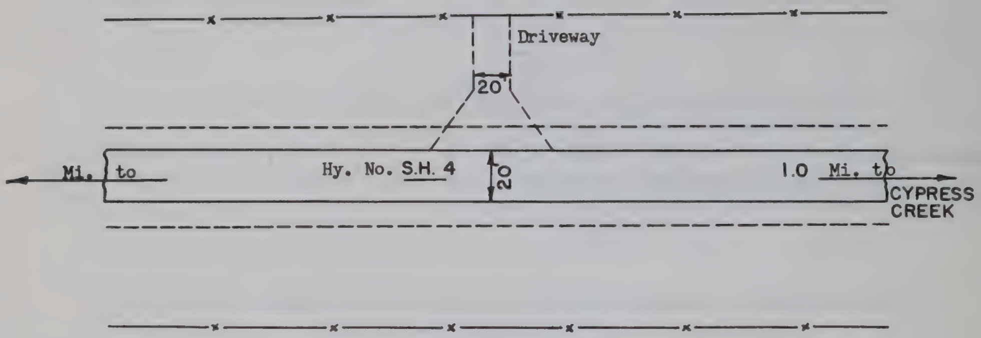
Pipe Cross Section



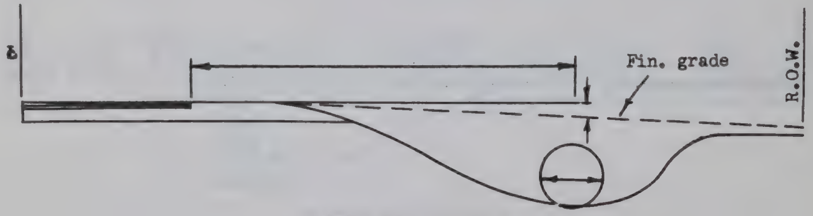
Valley Gutter
Cross Section

Property Owners Name JOHN DOE

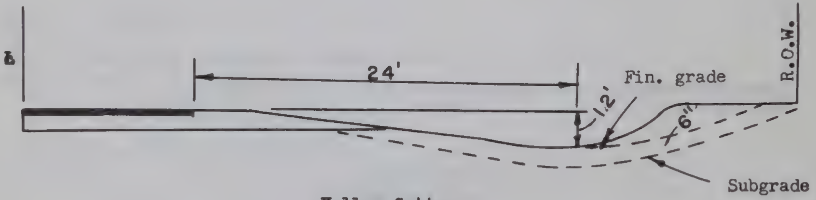
R.O.W.



Driveway Layout



Pipe Cross Section



Valley Gutter
Cross Section

THE STATE OF TEXAS

Personnel Changes

H.L. Arno, Director of Personnel

1. District 20, District Headquarters, Beaumont: J.D. Reagan Jr., changed from Senior Designing Engineer to Senior Resident Engineer August 16, 1953.
2. Administration, Austin: F.S. Maddox, Assistant State Highway Engineer, resigned August 31, 1953.

* * *

"I've warned those two flagmen for the last time about talking too much on the job!"

GRID ROLLERS . . .
FOR PROCESSING BASE MATERIALS

M.B. Hodges, District Engineer
District 22

In many areas of this district base materials are very hard and should be processed. This would likely increase the cost per yard as much as 50 cents, and due to the amount of money involved it is usually not done. On the other hand, when processing is not done much of the material is "wasted" by blading into the ditches or otherwise disposing of it.

After having read two or three articles on the use of grid rollers, we leased one on June 1, and started using it during the placing of the base on Project M-369-1-7 on S. H. 127 in Uvalde County. At first we had quite a bit of difficulty in securing good results primarily because we were unable to place enough weights on the roller to perform satisfactory work. The company cooperated very readily and equipped the roller with four and one-half-inch solid steel shafting in groups of six or eight to bring the total weight to 30, 000 pounds, the roller weighing 12, 000 pounds and the shafting 18, 000 pounds. Since that time results have been very satisfactory.

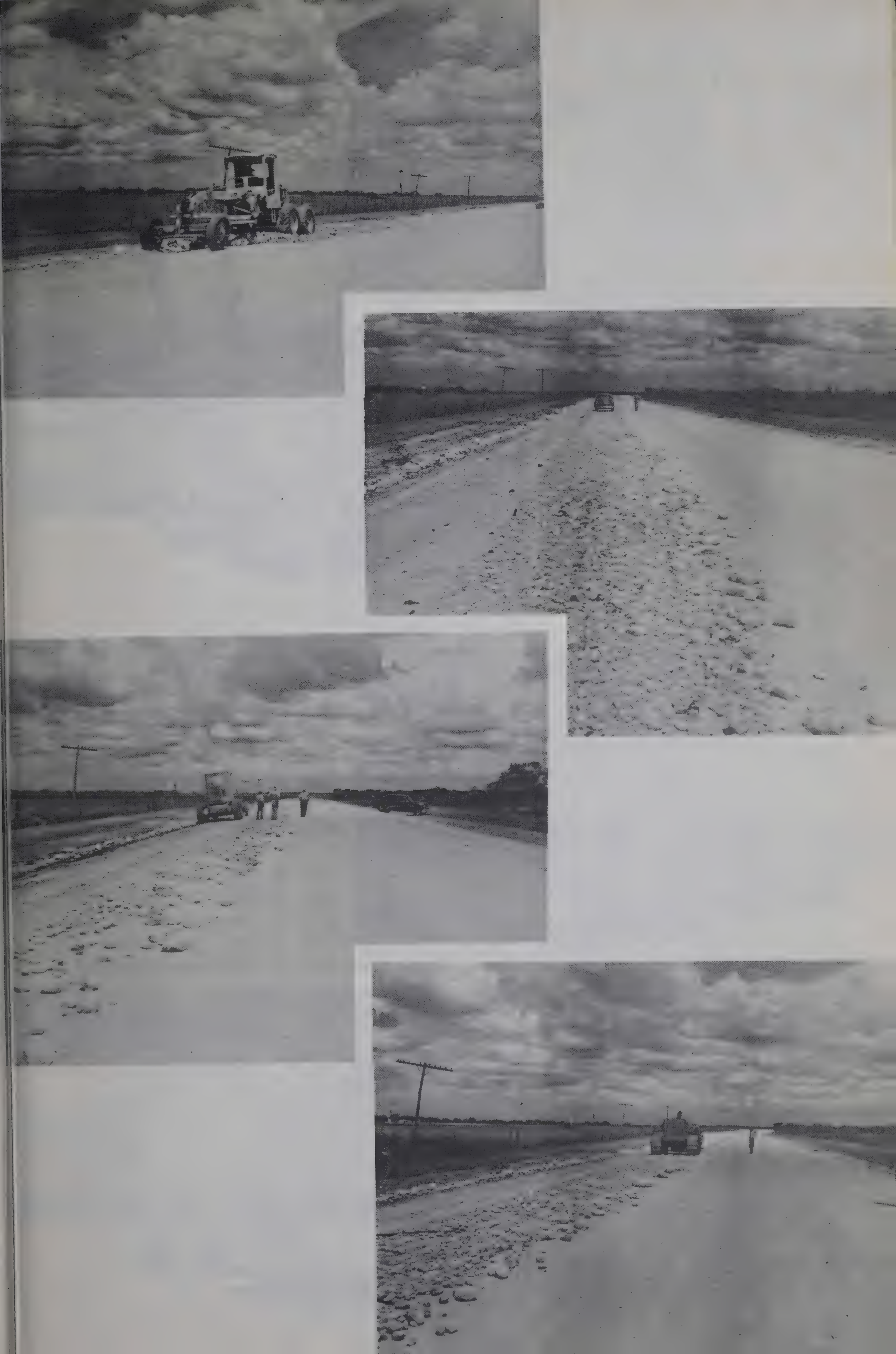
M. F. Lowe, Construction Superintendent, and I did some experimenting about a week ago on the project after the first course of caliche had been placed. As usual, we had the excessive amount of coarse material which was bladed into the ditch. This was occasioned by the fact that the grid roller could not break the large stone because there was nothing hard to push against. As a result, windrows of this material were bladed to the side of the first course of caliche. After the caliche had been under traffic some two or three weeks, we brought a portion of the roll to about the quarter point, as noted in the picture, and then began using the grid roller in an effort to break up or pulverize the stones.

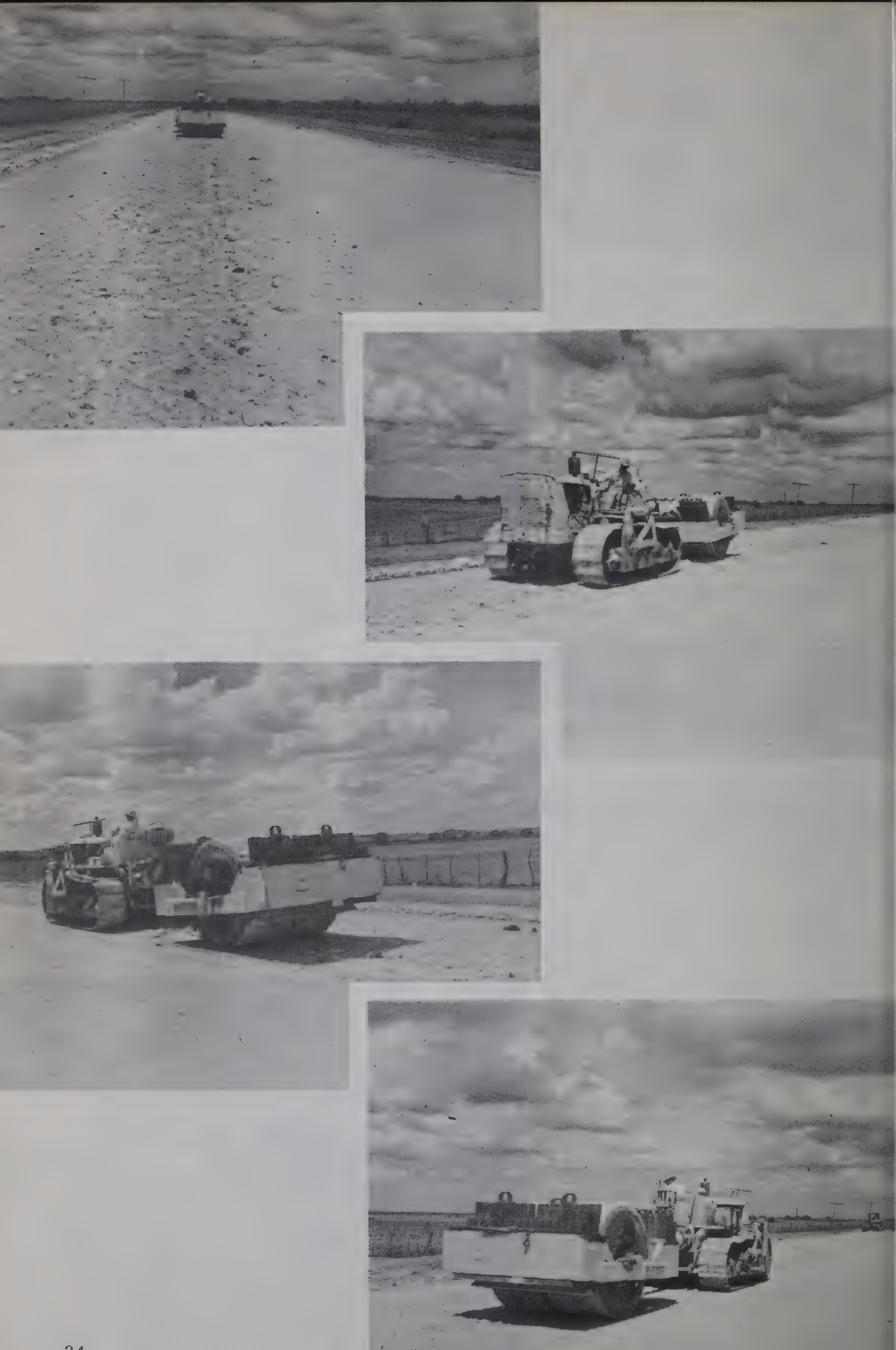
The pictures were taken during the course of this operation and I believe you will note that the results are rather satisfactory.

We feel, however, that the stone should have been brought to the center of the road where the base was more compacted and dense, and quite naturally harder. In the future this procedure will be followed.

As far as we can determine, there is only one objection to doing this and that is the fact that an excessive amount of coarse material is left on the surface of the road. On this particular project where we were using 60-pound limestone rock asphalt as a surfacing material this is not particularly detrimental, but it certainly would be in case of a single or a double being placed. However, by so doing we do utilize practically all of the metal incorporated in the caliche, which heretofore has been "wasted."

From results obtained by the use of this roller to date, we think that it is a very satisfactory piece of equipment.





E. D. Parmer, Assistant District Engineer
District 20

EQUIPMENT INSPECTION RECORD FORMS

The three forms presented here are now being used in District 20 as part of a scheme devised by our Equipment Supervisor, O. A. Keith, to keep records of the inspection of equipment in order to assure proper care and maintenance of the equipment.

We now have 388 pieces of equipment, of which 181 are vehicles equipped with speedometers. The balance of 207 consists of heavy equipment, draglines, maintainers, discs, and pumps, of which a total of 122 require regular operators. It can readily be seen that some system is necessary to assure that "first echelon maintenance" is being carried out.

A small notebook is kept in the glove compartment of each piece of speedometer equipment. The operator is instructed to make notations of anything that needs attention for the benefit of the traveling mechanic and for shop use. If it is a matter needing immediate attention, he is instructed to contact his supervisor at once, who in turn relays the need to the equipment supervisor.

Our Field Equipment Inspector, H. A. Smith, strives to check each piece of equipment at least once a month. The equipment supervisor gives him assistance by concentrating on heavy equipment and making spot checks on automotive equipment as he has the opportunity.

When the field inspection is being made, Form 2 is used for automotive equipment and Form 3 for heavy equipment and other equipment. The inspection report serves as a guide to be sure that nothing is overlooked and as a record of the inspection. If the needed repair is of a minor nature and the inspector makes the repair in the field, he indicates it on Form 2 or 3. Also, if adjustments are made, he indicates that with letter "x," and, if repairs are needed which he cannot handle, he indicates with letter "c." If he is inspecting automotive equipment, he checks the equipment notebook for any notes and makes a notation in the book indicating the date, the nature of any repairs made, and any needed.

Each morning the equipment supervisor takes the field inspection reports from the previous day and applies the data to the check sheet, Form 1. This check sheet enables the equipment supervisor to tell at a glance the status of inspections and repairs for each piece of equipment.

Form No. 1

Check Sheet for Field Inspection Reports

Equipment No.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
120-F	✓			✓								
121-F	✓	O	O	✓								
122-F	O	✓		✓								
123-F	O	✓	✓									
129-C	T	T	T	T								
139-F	✓	O	O									
140-F			✓	✓								
144-D	T	T	T	T								
184-E	O	✓	✓	✓								
196-E			✓	✓								
1045-A	O		✓									
1058-A	O	✓	✓	O								
1067-A	O			✓								
1116-A	O	O										
1117-A	✓	✓		✓								
1190-A	✓			O								
1209-A	✓	✓	✓	✓								
1218-A	✓			✓								
1220-A	✓	✓	✓	✓								
1226-A	O	✓	✓									
1227-A	O		✓	✓								
1352-A	O		O									
1381-A		O	✓									
1382-A	O											

Code Used:

(T) - Trade (Scheduled for trade-in, no major repairs to be made
(O) - Repairs needed
(✓) - O.K.
(S) - In Shop for repairs

Form No. 2

FIELD INSPECTION REPORTS
AUTOMOTIVE EQUIPMENT

Equipment No. 4248-C License No. XH 2759 Miles 29400 Date 4-27-53

Type of Operation: "✓" O. K. - "X" Adjusted - "O" Repair Needed - "R" Repair Made

FRONT END
- ✓ Axle
- ✓ Springs
- ✓ Hangers
- ✓ Shackles
- ✓ Tie Bolts
- ✓ Spindles
- ✓ Wheel Bearing
- ✓ Control Arms
- ✓ Alignment
- ✓ Shocks and Linkage

STEERING GEAR
- ✓ Sector Bearings and Adjustment
- ✓ Drag Link
- ✓ Tie Rods & Ends
- ✓ Column & Bearings

INSTRUMENTS
- ✓ Speedometer, cable, gear
- ✓ Fuel gage, tank unit wire
- ✓ Oil pressure, sender, wire
- ✓ Temp gage, sender, wire
- ✓ Ammeter

MOTOR
- ✓ Mounts
- ✓ Compression
- ✓ Power
- ✓ Governor setting
- ✓ Valve Adjustment
- ✓ Oil Pump Pressure
- ✓ Using Oil, oil leaking
- Side cover, valve cover
- Filter & Lines

TRANSMISSION
- ✓ Housing & Seals
- ✓ Hard to shift
- ✓ Hangs in gear
- ✓ Jumps out of gear
- ✓ Noisy

CLUTCH
- ✓ Adjustment
- ✓ Return spring
- ✓ Pedal & Bushing
- ✓ Throwout bearing
- ✓ Slipping, grabbing

DRIVE SHAFT
- ✓ U Joints
- ✓ Bell Housing
- ✓ Jack Shaft bearing
- ✓ Shaft condition

COOLING SYSTEM
- ✓ Radiator
- ✓ Water Hose
- ✓ Heater Hose
- ✓ Fan Belt
- ✓ Scale, Rust, Oil
- ✓ Pump, packing, gasket
- ✓ Thermostat

ELECTRICAL SYSTEM
- ✓ Battery
- ✓ Cable & Terminals
- ✓ Generator
- ✓ Starter & Linkage
- ✓ Horn, wire, button
- ✓ Clearance, direction Lights
- ✓ Park, Tail, Stop Lights
- ✓ Dimmer Switch

BODY AND CAB
- ✓ Bumper, Bolts, Bracket
- ✓ Doors, Hinges
- ✓ Handle, Latch, Lock
- ✓ Frame
- ✓ Fenders
- ✓ Mirror
- ✓ License Mounting
- O Seats
- ✓ Paint condition
- ✓ Cab, bed mount, bolts
- ✓ Windows, glass
- ✓ Windshield wiper, Arms, blades

FUEL SYSTEM
- ✓ Air Filter
- ✓ Fuel Lines
- ✓ Accelerator Linkage
- ✓ Choke, throttle
- ✓ Carburetor gasket
- ✓ Pump, strainer, bowl
- ✓ Tank, bracket, strap
- ✓ Manifold Gasket

EXHAUST SYSTEM
- ✓ Exhaust pipe, gasket
- ✓ Muffler, clamps, straps,

EXHAUST SYSTEM, CONT'D
- ✓ Tail Pipe, clamp, strap

DUMP BODY
- ✓ Hydraulic cylinder
- ✓ Tail gate, pins, control
- ✓ Hydraulic controls
- ✓ Mud Flaps

REAR AXLE
- ✓ Axle, housing, studs
- ✓ Cover & Gasket
- ✓ Differential gears, brgs
- ✓ Pinion gear, seal
- ✓ Sprirgs, hanger, shackle
- ✓ Tie Bolts, shocks
- ✓ Radius Rods
- ✓ Axle Shift, vacuum

IGNITION
- ✓ Switch
- ✓ Coil
- ✓ Points & Condenser
- ✓ Plugs
- ✓ Distributor, Cap, Finger
- ✓ Timing
- ✓ Wire, primary, secondary

BRAKES
- ✓ Wheel cylinder
- ✓ Master cylinder
- ✓ Lines & Lining
- ✓ Vacuum Booster
- ✓ Air Brakes

TIRES
- ✓ Front L
- ✓ Front R
- ✓ Rear L
- ✓ Rear L
- ✓ Rear R
- ✓ Rear R

WHEELS
- ✓ Front L
- ✓ Front R
- ✓ Rear L
- ✓ Rear L
- ✓ Rear R
- ✓ Rear R

REMARKS
Needs seat covers and floor mat

County Liberty
Maintenance J.-Woosley
Engineering

Inspection by:
H. H. Smith

Form No. 3

FIELD INSPECTION REPORTS
HEAVY EQUIPMENT

Equipment No. 1946 Type Adams Maintainer Date 4-27-53

Type of Operation to be Performed: "✓" if O.K. - "X" Adjusted - "O" Repairs Needed - "R" Repairs Made

COOLING SYSTEM
✓ Radiator Condition
✓ Water hose - fan belt
✓ Water pump

MOTOR
✓ Knocking
✓ Not pulling
✓ Gets too hot
✓ Cuts out at low speed
✓ Oil Pump
✓ Hard to start on diesel
✓ Hard to start on gas
✓ Smokes on diesel
✓ Injector nozzels

FUEL SYSTEM
✓ Carburetor
✓ Fuel Pump
✓ Fuel Lines and tank

FILTERS
✓ Oil filter
✓ Fuel filter
✓ Air filter

CLUTCHES
O Clutch slipping
✓ Clutch grabs
✓ Clutch noisy
✓ Clutch controls
✓ Clutch adjustments

TRANSMISSION
✓ Jumps out of gear
✓ Noisy
✓ Hard to shift

FRONT AXLE
✓ Spindle and bushings
✓ Tie rod ends
✓ Steering gear
✓ Steering hard

REAR AXLE
✓ Hubs
✓ Tandem drives
✓ Differential noisy
✓ Grease leaks
✓ Universal joints
✓ Drive Shaft

BRAKES
✓ Adjustment
✓ Lining
✓ Master cylinder
✓ Brake cylinder

TRACK & FRAME SYSTEM
___ Track chains
___ Track rollers
___ Front idlers
___ Sprockets
___ Final drives
___ Steering clutches
✓ Tires, front
✓ Tires, rear

HYDRAULIC SYSTEM
✓ Hydraulic pump
✓ Station Valve
✓ Blade lifts
✓ Hydraulic steering
✓ Hydraulic hose
✓ Hydraulic operating controls

ASPHALT TANKS
___ Burners
___ Blowers
___ Pumps & Spraybars

DRAGLINE
___ Boom
___ Shieves
___ Center pin and bushing
___ Swing controls
___ Hoist and drag
___ Outside gears
___ Drive Chains

FRONT END LOADER
___ Bucket arms
___ ___________
___ ___________

ROLLERS -- PNEUMATIC & SHEEPFOOT
___ ___________
___ ___________
___ ___________

DISC
___ ___________
___ ___________

MISCELLANEOUS EQUIPMENT
___ ___________
___ ___________
___ ___________
___ ___________

REMARKS
Clutch slipping

Inspection by:

O. A. Keith

Date: 4-27-53

"Comments From the Traveling Public"
OVER THE HIGHWAYS

. . . Yesterday afternoon about 4:15 on Northwest Highway at Shadybrook Lane, one of your drivers did a great service for me.

I had pulled off Northwest Highway because I no longer could see to drive in the downpour, and got off onto an extremely soft shoulder.

He was courteous and generously pulled our car out of the mud and then would accept no money from me.

He was driving truck with license $\overset{X}{H}$ 6245 and the number on the side was 18-3216-E.

Both the driver and his helper were so nice and I want to take this opportunity to thank them again and to commend them to you.

(Mrs. P. C.) K. Friday
Dallas, Texas

. . . We found that highways were not clearly marked through centers of cities . . .

Atwood, Kansas

. . . The highway signs are not specific enough. Too apt to dash upon a bad corner without proper signs . . .

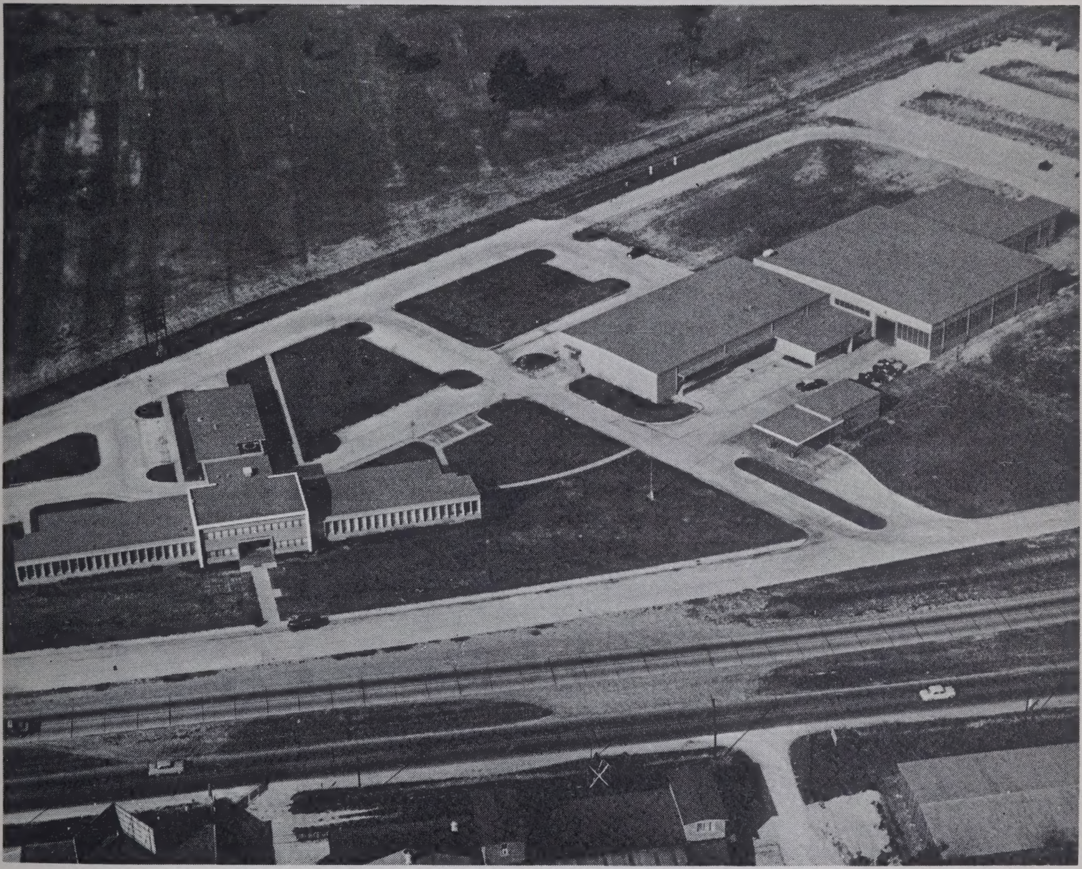
Livermore, California

. . . We didn't like the lack of mileage markers - your distances are so great, one needs to know how far away the next town is as one drives along . . .

Los Angeles, California

. . . I'm a construction engineer and the way you handle your traffic during road construction was outstanding and all roads are a good job well done . . .

Saint Louis, Missouri



AIR VIEW OF THE NEW HOUSTON DISTRICT HEADQUARTERS